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(19)

(54) A LASER AMPLIFIER

(71) We, COMPAGNIE INDUSTRIELLE DES LASERS, a French Corporation, of Route de Nozay, 91460 Marcoussis, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention concerns a laser amplifier.

It is known that the amplifying of a laser beam may be effected by directing the said beam onto an active medium which is excited or pumped by means of short light pulses, the angle of incidence of the laser beam on the said active medium being, to great advantage, equal to the Brewster angle.

The pumping of the active medium is generally effected by means of rectilinear discharge tubes arranged on either side of the active medium.

The pumping of the active medium may also be effected by means of a circular lamp surrounding the incident beam.

These amplifiers have disadvantages. Rectilinear tubes have a relatively short service life because damage is caused to their ends due to the shock wave generated by the successive discharges. Moreover, it is difficult to remove the active medium from within the tubes, more particularly when it is required to clean it or change it. Pumping by means of a circular tube causes a relatively low degree of amplification.

Spurious super-radiance phenomena which it is not easy to combat are observed in the operation of these amplifiers.

Moreover, such amplifier circuits have a realively high cost price.

The present invention makes it possible to overcome the above-mentioned disadvantages of known amplifiers and it aims at producing a laser amplifier making it possible to obtain a maximum amplifying rate while having a simple, practical structure, for a low cost price.

Accordingly, the present invention provides a laser amplifier comprising an active medium limited by an input face, an output face and a peripheral lateral surface disposed between said input and output faces, said input face being arranged to receive an incident beam travelling along a path which is surrounded by a helical discharge tube, said discharge tube being arranged to emit light onto said input face for exciting said active medium in order to amplify said incident beam, and an enclosure containing a substance capable of absorbing any spurious superradiance radiations disposed around said peripheral surface.

The invention will now be described in more detail, by way of example only, with reference to the accompanying drawings, in which:—

figure 1 shows diagrammatically an elevation view of a laser amplifier according to the invention,

figure 2 shows a side view of figure 1,

figure 3 shows an example of a practical embodiment of a laser amplifier according to the invention.

With reference to figures 1 and 2, reference 1 designates an active medium, in this instance, a glass disk doped with neodymium, whose thickness is in the order of a tenth of its diameter. The laser beam 2 to be amplified is pointed at an angle of incidence a equal to the Brewster angle.

A helical discharge tube 3 for pumping the glass disk 1 is wound round the incident laser beam 2. The winding diameter D of such a tube is greater than and close to the diameter of the incident beam 2. The length L of such a tube is predetermined as a function of the inversion

of the population required in the active medium, on the one hand, and of the efficiency of the pumping, on the other hand.

In other words, if a high inversion of population is required in the material of the disk, a tube having a great length will be taken. On the other hand, if a high pumping efficiency is required, a tube having a relatively short length will be chosen.

An enclosure 4 containing a liquid 5 such as bromoform dissolved in ethanol, or dimethylsulfoxyde, is arranged on the periphery of the disk 1, such an enclosure forming a trap intended for absorbing the spurious super-radiance radiation generated in the vicinity of the periphery of the disk.

Lastly, the emergent amplified laser beam is shown at 6.

Of course, such amplifiers may be arranged in series and thus, amplification stages may be formed. As shown in figure 1, the emergent beam 6 may be pointed towards another disk 1′ provided with a trap 4′, another helical tube 3′ being wound round the said beam 6.

The advantages of such a device according to the invention are as follows:

In the first instance, helical discharge tubes have a very much higher resistance to mechanical damage than linear tubes, the shock wave generated by the discharges being damped because of the circular path thus followed; moreover, the removal of the disk with a view to the cleaning or replacing thereof in the structure as a whole is effected very easily by a simple lateral linear movement.

Furthermore, the shape of the disk is not determined by the structure; the spurious super-radiance phenomenon can therefore be attenuated by suitable shapes; on the other hand, the diameter of the discharge tube being very close to the diameter of the incident beam, the pumping efficiency therefore has a maximum value.

It will be observed also that it is particularly easy to arrange the liquid trap at the periphery of the disk and to cancel, by this means, the spurious super-radiance phenomenon.

Moreover, from the point of view of practical embodiment, sealed assemblies which are easily transportable may be manufactured at a low cost.

Such an example of embodiment is described with reference to figure 3.

Figure 3 therefore shows a parallelepiped box 10 cast in one piece whose main lateral faces 11 and 12 each comprise an opening 13 and 14 respectively. These openings are arranged in such a way that the straight line 15 joining the centres forms, with the faces 11 and 12, an angle equal to the complement of the Brewster angle.

The glass disk 1 is fixed by any suitable means against the face 11 and opposite the opening 13.

The helical discharge tube or tubes 3 are arranged inside the housing 10.

The laser beam (not shown) therefore enters the box 10 through the opening 14, moves along inside the tube or tubes 3 and emerges through the opening 13 and the disk 1.

It will therefore be understood that amplifying stages may be formed in connection with the boxes 10 such as described hereinabove.

The invention is therefore implemented to great advantage in the technical field of lasers.

WHAT WE CLAIM IS:—

1. A laser amplifier comprising an active medium limited by an input face, an output face and a peripheral lateral surface disposed between said input and output faces, said input face being arranged to receive an incident beam travelling along a path which is surrounded by a helical discharge tube, said discharge tube being arranged to emit light onto said input face for exciting said active medium in order to amplify said incident beam, and an enclosure containing a substance capable of absorbing any spurious superradiance radiations disposed around said peripheral surface.

2. A laser amplifier according to claim 1, wherein said active medium is in the shape of a disk and the axis of the said discharge tube forms, with the normal to the input face, an angle equal to the Brewster angle.

3. An amplifier according to claim 1, wherein the length of the said helical discharge tube is predetermined as a function of the rate of inversion of the population in the said active medium on the one hand and of the pumping efficiency on the other hand.

4. A laser amplifier substantially as described with reference to and as illustrated in the accompanying drawings.

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1 SHEET
This drawing is a reproduction of the Original on a reduced scale

FIG.1

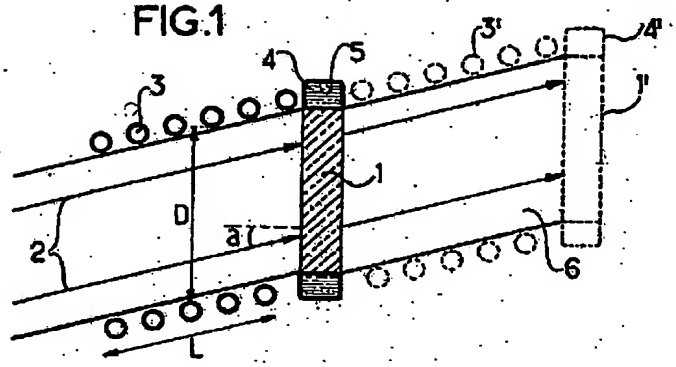

FIG.2

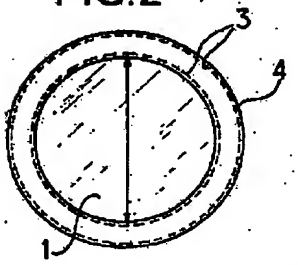

FIG.3